CIE Chemistry IGCSE

Topic 14 - Organic Chemistry

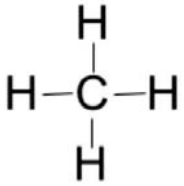
Flashcards

What is the displayed formula for the first two alkanes?

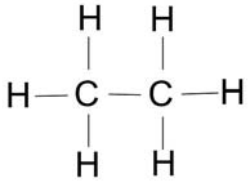
What are the names and chemical formulae of the first two alkanes?

What is the displayed formula for the first two alkanes?

Methane:



Ethane:



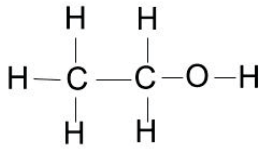
What are the names and chemical formulae of the first two alkanes?

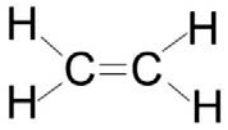
Methane (CH_4)

Ethane (C_2H_6)

Write the chemical and displayed formulae of ethanoic acid

Name the following structures:

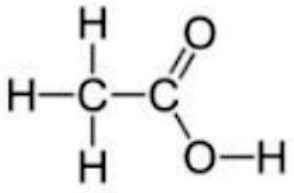




Write the chemical and displayed formulae of ethanoic acid

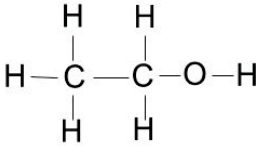
Chemical formula: CH_3COOH

Displayed formula:

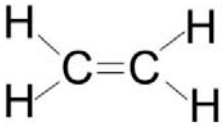


Name the following structures:

Ethanol:



Ethene:



Name the first four alcohols and carboxylic acids
(extended only)

Name the first four alkanes and the first three alkenes
(extended only)

Name the first four alcohols and carboxylic acids (extended only)

Alcohols:

- Methanol
- Ethanol
- Propanol
- Butanol

Carboxylic acids:

- Methanoic acid
- Ethanoic acid
- Propanoic acid
- Butanoic acid

Name the first four alkanes and the first three alkenes (extended only)

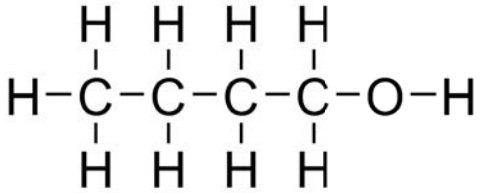
Alkanes:

- Methane
- Ethane
- Propane
- Butane

Alkenes:

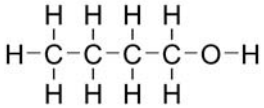
- Ethene
- Propene
- Butene

Name the compound below. What is its chemical formula?
(extended only)



Draw the displayed formula of propanol and propanoic acid
(extended only)

Name the compound below. What is its chemical formula? (extended only)



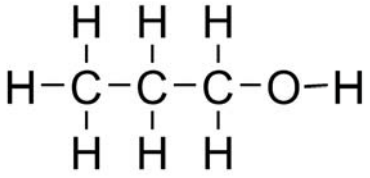
Name: Butanol

Chemical formula: $CH_3CH_2CH_2CH_2OH$

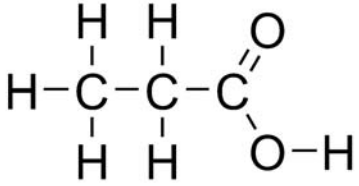
(or C_4H_9OH)

Draw the displayed formula of propanol and propanoic acid (extended only)

Propanol:



Propanoic acid:



What type of compound has the molecular formula C_2H_4?

What type of compound is present when the name ends in -ane, -ene, -ol or -oic acid?

What type of compound has the molecular formula C_2H_4?

Alkene

C_2H_4 is the molecular formula for ethene.

What type of compound is present when the name ends in -ane, -ene, -ol or -oic acid?

-ane → alkane

-ene → alkene

-ol → alcohol

-oic acid → carboxylic acid

How is an ester formed? Write a general equation for the reaction that produces an ester
(extended only)

What type of compound has the molecular formula $C_3H_6O_2$?

How is an ester formed? Write the general equation for the reaction that produce an ester (extended only)

An ester is formed when a carboxylic acid and alcohol are reacted together.

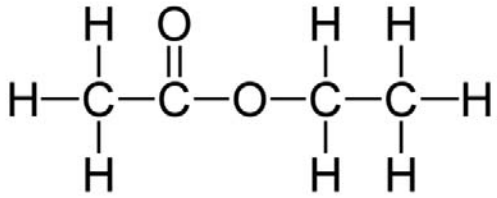
Alcohol + carboxylic acid → ester + water

What type of compound has the molecular formula $C_3H_6O_2$?

Carboxylic acid

$C_3H_6O_2$ is propanoic acid (extended only).

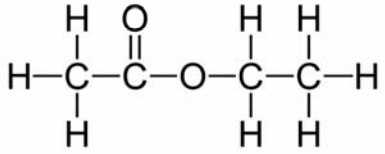
Name the ester shown below:
(extended only)



How do you name esters?
(extended only)

Name the ester shown below: (extended only)

Methyl ethanoate



How do you name esters? (extended only)

(Prefix of the alcohol)-yl + (name of carboxylic acid minus 'oic acid')-anoate.

E.g. An ester formed from propanol and ethanoic acid would be propyl ethanoate.

Name three fossil fuels

Draw the displayed formula of ethyl ethanoate
(extended only)

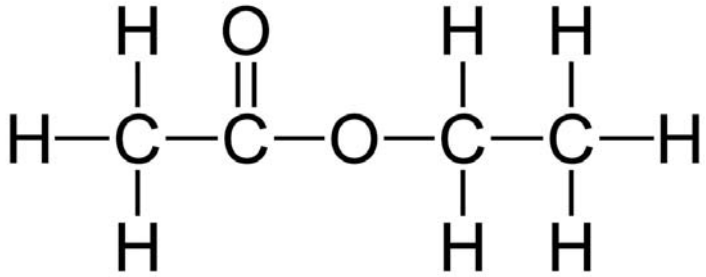
Name three fossil fuels

Coal

Natural gas

Petroleum (crude oil)

Draw the displayed formula of ethyl ethanoate?
(extended only)



What is petroleum?

What is the main constituent of natural gas?

What is petroleum?

Petroleum (also known as crude oil) is a mixture of hydrocarbons.

What is the main constituent of natural gas?

Methane

Crude oil can be separated into fractions by fractional distillation. What are the differences between hydrocarbons at each fraction?

Name and describe the process which can be used to separate petroleum

Crude oil can be separated into fractions by fractional distillation. What are the differences between hydrocarbons at each fraction?

- Boiling points
- Ease of ignition
- Viscosity
- The number of hydrogen and carbon atoms in the molecules.

Name and describe the process which can be used to separate petroleum

Fractional distillation:

1. The petroleum is vaporised and released into a fractionating column.
2. The column has a temperature gradient and is hotter at the bottom.
3. The hydrocarbon vapours rise up the column and condense at different fractions due to their different boiling points. Hydrocarbons with a lower boiling point will condense further up the column.

What are the properties of hydrocarbons that are tapped from the top of the fractionating column?

Where in the fractionating column do hydrocarbons with the highest viscosity condense?

What are the properties of hydrocarbons that are tapped from the top of the fractionating column?

- Low boiling point
- Highly volatile
- Easily ignited
- Shorter carbon chains (small molecules).

Where in the fractionating column do hydrocarbons with the highest viscosity condense?

Viscosity is how thick and sticky a substance is.

The hydrocarbons with the highest viscosity (like bitumen) are collected at the bottom of the fractionating column.

Refinery gas is a fraction of petroleum. What are its common uses?

Why is petroleum separated?

Refinery gas is a fraction of petroleum. What are its common uses?

Heating and cooking.

Why is petroleum separated?

Unseparated petroleum isn't very useful but the separated products are very useful.

Naphtha is a fraction of petroleum. What is a common use of naphtha?

Which fraction of petroleum is used as fuel in cars?

Naphtha is a fraction of petroleum. What is a common use of naphtha?

Making chemicals

Which fraction of petroleum is used as fuel in cars?

Petrol (gasoline)

Diesel is also less commonly used.

Diesel oil is fraction of petroleum. What is it commonly used for?

Kerosene is a fraction of petroleum. What is a common use of kerosene?

Diesel oil is a fraction petroleum. What is it commonly used for?

Fuel for some cars and trains.

Kerosene is a fraction of petroleum. What is a common use of kerosene?

Aircraft fuel

What are products from the lubricating fraction of petroleum used for?

Fuel oil is a fraction of petroleum. What is it commonly used for?

What are products from the lubricating fraction of petroleum used for?

Lubricants, waxes and polishes.

Fuel oil is a fraction of petroleum. What is it commonly used for?

Fuel for large ships and in some power stations.

What is a homologous series?

Which fraction of petroleum is used for road surfacing and roofs?

What is a homologous series?

A family of similar compounds with similar chemical properties due to the presence of the same functional group.

Which fraction of petroleum is used for road surfacing and roofs?

Bitumen

What is a general formula?
(extended only)

What are the general characteristics of a homologous series?
(extended only)

What is a general formula? (extended only)

A formula that represents the composition of any member in a homologous series.

What are the general characteristics of a homologous series? (extended only)

- Similar chemical properties.
- All contain the same functional group.
- Adjacent molecules in the series differ by CH_2.

What is structural isomerism?
(extended only)

What are the general formulas for alkanes and alkenes?
(extended only)

What is structural isomerism? (extended only)

Structural isomerism is when compounds have the same molecular formula but a different arrangement of atoms.

What are the general formulas for alkanes and alkenes? (extended only)

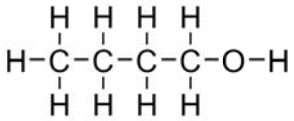
Alkanes: C_nH_{2n+2}

Alkenes: C_nH_{2n}

Describe the reactivity of alkanes

Which of the following compounds show structural isomerism? (extended only)

1.



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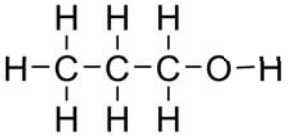

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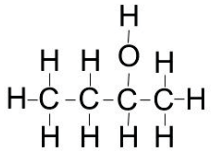
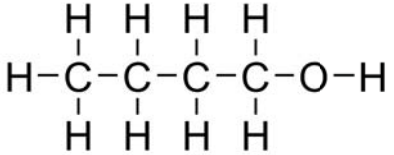


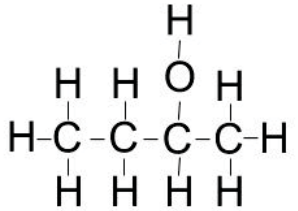
Describe the reactivity of alkanes

Generally very unreactive (except burning).

Which of the following compounds show structural isomerism? (extended only)

1 and 3 are structural isomers





What is required for alkanes to react with chlorine?
(extended only)

Describe the bonding in alkanes

What is required for alkanes to react with chlorine?
(extended only)

UV radiation

Describe the bonding in alkanes

- Saturated (only contain single covalent bonds).
- Each carbon atom forms four covalent bonds.
- Contain C-C and C-H covalent bonds.

Write the word and chemical equations for the reaction between methane and chlorine
(extended only)

Write the general equation for the reaction between an alkane and a halogen
(extended only)

Write the word and chemical equations for the reaction between methane and chlorine
(extended only)

Methane + chlorine → methyl chloride + hydrogen chloride

$$CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$$

Write the general equation for the reaction between an alkane and a halogen (extended only)

Alkane + halogen → haloalkane + hydrogen halide

What are the products of cracking?

Describe how alkenes can be manufactured

What are the products of cracking?

Shorter chain alkanes

Alkenes

Hydrogen

Describe how alkenes can be manufactured

By cracking long chain alkanes.

Long chain hydrocarbons are heated until vaporised. The vapours are passed over a hot catalyst to break the long chains. Alternatively, the vapours are mixed with steam at very high temperatures so that thermal decomposition occurs.

How can you distinguish between saturated and unsaturated compounds?

What's the difference between saturated and unsaturated compounds?

How can saturated and unsaturated compounds be distinguished between?

Add bromine water.

Bromine water is decolourised in unsaturated compounds (alkenes) whereas it remains orange in saturated compounds (alkanes).

What's the difference between saturated and unsaturated compounds?

Saturated - only contain single covalent bonds.

Unsaturated - contain at least one double bond.

In terms of alkenes, what is an addition reaction?
(extended only)

Why do alkenes decolourise bromine water?

In terms of alkenes, what is an addition reaction?
(extended only)

The addition of hydrogen, a halogen or steam across the C=C double bond. The product doesn't contain a C=C double bond.

Why do alkenes decolourise bromine water?

Alkenes are unsaturated. The double bond allows alkenes to react with bromine to form a bromoalkane.

Write the word and balanced symbol equations for the reaction between ethene and bromine
(extended only)

What are the different products formed when an alkene undergoes addition reactions with bromine, hydrogen and steam?
(extended only)

Write the word and balanced symbol equations for the reaction between ethene and bromine (extended only)

Ethene + Bromine → 1,2-dibromoethane

$C_2H_4 + Br_2 \rightarrow C_2H_4Br_2$

What are the different products formed when an alkene undergoes addition reactions with bromine, hydrogen and steam? (extended only)

Addition with bromine: Dibromoalkane.

Addition with hydrogen: Alkane.

Addition with steam: Alcohol.

Write the word and balanced symbol equations for the reaction between ethene and steam
(extended only)

Write the word and balanced symbol equations for the reaction between propene and hydrogen
(extended only)

Write the word and balanced symbol equations for the reaction between ethene and steam
(extended only)

Ethene + steam → ethanol

$C_2H_4 + H_2O \rightarrow C_2H_5OH$

Write the word and balanced symbol equations for the reaction between propene and hydrogen
(extended only)

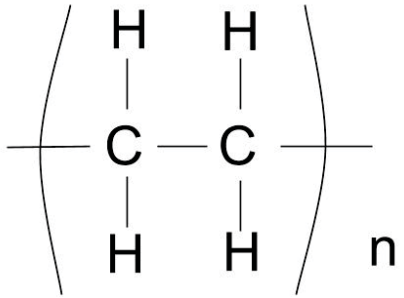
Propene + hydrogen → Propane

$C_3H_6 + H_2 \rightarrow C_3H_8$

Draw the displayed structure of poly(ethene)

How is poly(ethene) formed?

Draw the displayed structure of poly(ethene)



How is poly(ethene) formed?

Ethene monomers undergo addition polymerisation to form the long chain polymer poly(ethene).

Write the word and chemical equations for the fermentation of glucose to form ethanol

How can ethanol be manufactured by fermentation? What conditions are required?

Write the word and chemical equations for the fermentation of glucose to form ethanol

Glucose (+ yeast) → ethanol + carbon dioxide

$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

How can ethanol be manufactured by fermentation? What conditions are required?

Fermentation of glucose.

Conditions:

- Temperature around 30°C.
- Anaerobic (no oxygen).
- Yeast provides crucial enzymes.

Write the word and chemical equations for the production of ethanol from ethene

How can ethanol be produced from ethene? What conditions are required?

Write the word and chemical equationd for the production of ethanol from ethene

Ethene + steam → ethanol

$C_2H_4 + H_2O \rightarrow C_2H_5OH$

How can ethanol be produced from ethene? What conditions are required?

Ethene undergoes an addition reaction with steam.

Conditions:

- Phosphoric acid catalyst.
- 300°C temperature.
- Pressure 60-70 atm.

What are the advantages and disadvantages of producing ethanol by the reaction of ethene with steam? (extended only)

What are the advantages and disadvantages of producing ethanol by the fermentation of glucose? (extended only)

What are the advantages and disadvantages of producing ethanol by the reaction of ethene with steam? (extended only)

Advantages	Disadvantages
Continuous process	Non-renewable raw materials
Few workers needed	High temperature and pressure is expensive
Fast rate of reaction	A lot of energy needed
Pure product produced	Catalyst required

What are the advantages and disadvantages of producing ethanol by the fermentation of glucose? (extended only)

Advantages	Disadvantages
Renewable raw material from sugar cane	Batch process so not produced continuously
Conditions are not economically demanding	Manual labour required to harvest sugar cane
Only a small amount of energy is required	Slow process
Carbon neutral	Impure product requires further processing

Why can ethanol be used as a fuel?

Write a chemical equation for the complete combustion of ethanol

Why can ethanol be used as a fuel?

Because ethanol releases a lot of energy when burnt.

Write a chemical equation for the complete combustion of ethanol

$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$

What are the properties of aqueous ethanoic acid?

What are the common uses of ethanol?

What are the properties of aqueous ethanoic acid?

- Colourless liquid
- Smells of vinegar

What are the common uses of ethanol?

- Fuel
- Solvent

Explain whether ethanoic acid is a strong or weak acid
(extended only)

How can ethanoic acid be made from ethanol?
(extended only)

Explain whether ethanoic acid is a strong or weak acid (extended only)

Aqueous ethanoic acid is a weak acid because it partially dissociates in solution to release some H^+ ions.

How can ethanoic acid be made from ethanol? (extended only)

Ethanol can be oxidised in two different ways to form ethanoic acid:

- Microbial oxidation (ethanol reacts with oxygen in the air to form ethanoic acid).
- Ethanol reacts with acidified potassium manganate(VII) to form ethanoic acid.

What are polymers?

How is an ester formed?
(extended only)

What are polymers?

Polymers are large molecules built up from small units called monomers.

How is an ester formed? (extended only)

A carboxylic acid reacts with an alcohol in the presence of a catalyst.

How can polymers differ from one another?
(extended only)

How can polymers differ in terms of their linkages?
(extended only)

How can polymers differ from one another?
(extended only)

- Different units
- Different linkages

How can polymers differ in terms of their linkages?
(extended only)

Polymers can have different linkages depending on what monomers they are made from. The different polymer linkages are:

- Simple C-C linkage
- Amide linkage
- Ester linkage

Give two examples of man made fibres

What are some common uses of plastics?

Give two examples of man made fibres

Nylon

Terylene

What are some common uses of plastics?

- Bags
- Bottles
- Food packaging
- Toys

What is the difference between addition and condensation polymerisation? (extended only)

What are some common uses of man made fibres?

What is the difference between addition and condensation polymerisation? (extended only)

Addition polymerisation forms a polymer from alkene monomers. The C=C double bonds are removed, forming a saturated compound which contains a long chain of C-C single bonds.

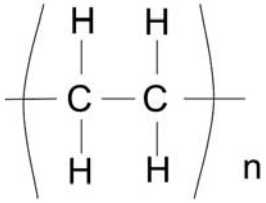
Condensation polymerisation forms a polymer by reacting compounds with two different functional groups together. A small molecule such as water is also produced.

What are some common uses of man made fibres?

- Woven into cloth for clothing.
- Rope
- Carpets
- Cotton can be mixed with nylon to make a soft but hard wearing material.

Name the polymer formed from propene. Draw its structure.
(extended only)

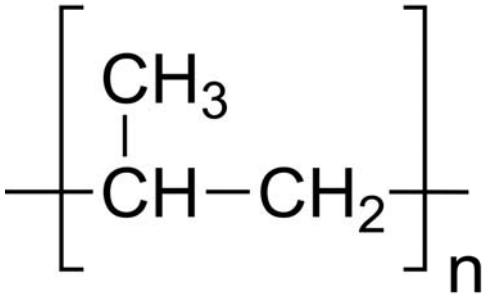
Name the alkene that forms the polymer below
(extended only)



Name the polymer formed from propene. Draw its structure. (extended only)

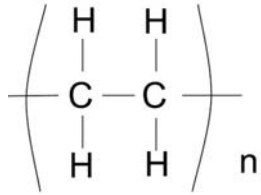
Poly(propene)

(Commonly known as polypropylene)



Name the alkene that forms the polymer shown below (extended only)

Ethene



What type of polymers are nylon and Terylene?
(extended only)

What are the pollution problems caused by non-biodegradable plastics?

What type of polymers are nylon and Terylene?
(extended only)

Nylon - polyamide

Terylene - polyester

What are the pollution problems caused by non-biodegradable plastics?

- Don't decompose in landfill.
- Take up a lot of space which could be used for animal habitat or vegetation.
- Incineration releases polluting gases like carbon dioxide and HCl (if the plastic contains chlorine).

How is a polyamide formed?
(extended only)

What process is used to form nylon and Terylene?
(extended only)

How is a polyamide formed? (extended only)

Two types of monomers react. One monomer contains two carboxylic acid groups and the other contains two amine groups. Water also produced.

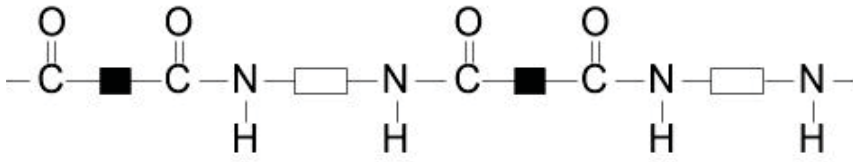
What process is used to form nylon and Terylene? (extended only)

Condensation polymerisation

How can the structure of nylon be represented?
(extended only)

How is a polyester formed?
(extended only)

How can the structure of nylon be represented?
(extended only)



How is a polyester formed? (extended only)

Two types of monomers react. One monomer contains two carboxylic acid groups and the other contains two alcohol groups. Water also produced.

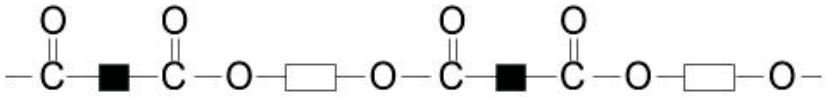
Fill in the gap: ‘Proteins and carbohydrates are constituents of _____’

How can the structure of Terylene be represented?
(extended only)

Fill in the gap: ‘Proteins and carbohydrates are constituents of _____’

Food

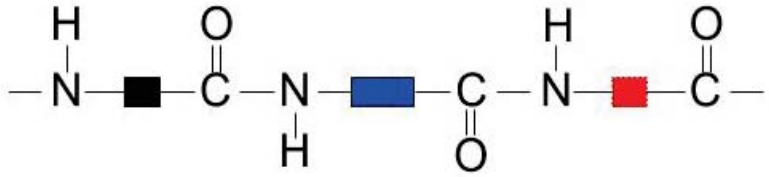
How can the structure of Terylene be represented?
(extended only)



How can the structure of a protein be represented?
(extended only)

Compare the structures of proteins and nylon
(extended only)

How can the structure of a protein be represented?
(extended only)



Compare the structures of proteins and nylon
(extended only)

- Same amide linkages
- Different polymer units

What are complex carbohydrates?
(extended only)

How can proteins be converted into amino acids?
(extended only)

What are complex carbohydrates? (extended only)

Lots of sugar unit (diols) joined together by condensation polymerisation.

How can proteins be converted into amino acids? (extended only)

Hydrolysis

Hydrolysis uses water to split up the protein polymer into its amino acid monomers.

How can complex carbohydrates by hydrolysed? What is produced? (extended only)

How can the structures of monomers and polymers of complex carbohydrates be represented? (extended only)

How can complex carbohydrates by hydrolysed? What is produced? (extended only)

Carbohydrates can be hydrolysed by acids or enzymes.

The product are simple sugars (the monomers of complex carbohydrates).

How can the structures of monomers and polymers of complex carbohydrates be represented? (extended only)

Monomer:

Polymer:

What conditions are required for simple sugars to undergo fermentation? (extended only)

What is produced when simple sugars are fermented? (extended only)

What conditions are required for simple sugars to undergo fermentation? (extended only)

- Yeast enzymes
- 30°C temperature
- Anaerobic (no oxygen)

What is produced when simple sugars are fermented? (extended only)

Ethanol and carbon dioxide

Why do sugars and amino acids require locating agents after chromatography? (extended only)

Describe how the products from the hydrolysis of carbohydrates and proteins can be separated (extended only)

Why do sugars and amino acids require locating agents after chromatography? (extended only)

Sugars and amino acids are colourless so locating agents are used to locate the substances on the chromatography paper.

How can the products from the hydrolysis of carbohydrates and proteins be separated? (extended only)

After the hydrolysis of carbohydrates and proteins, the mixture can be separated with chromatography.